German
Remote Sensing
Data Center
Land Surface
Dynamics

Optimized Processing of Airborne Hyperspectral Data for Forest Studies

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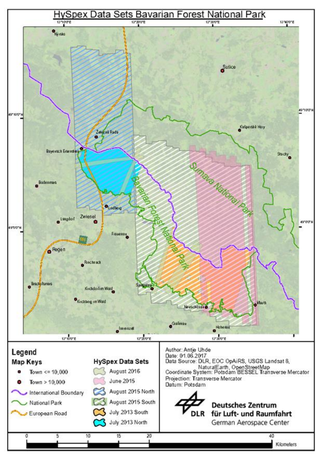
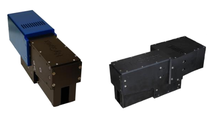
Overview

From 2013 onwards, regular airborne data acquisitions have been carried out with DLR's HySpex system in the frame of the "Data Pool Initiative for the Bohemian Forest Ecosystem". The hyperspectral imagery is used for different forest studies, e.g. tree species mapping.
In order to produce accurate and meaningful results from airborne hyperspectral data analysis, it is essential to have exact knowledge about the quality of the image data itself. Also, the application of a method to multitemporal data is dependent on the comparability of the data. In the following, the effort to generate standardized data products is being presented.





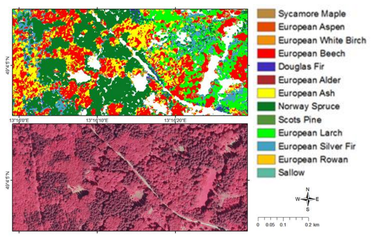
Parameter	VNIR 1600	SWIR 320m-e
Spectral range [nm]	416-992	968-2498
Spectral channels [#]	160	256
Sampling interval [nm]	3.6	6.0
Spatial resolution pixels [#]	1600	320

Processing Chain

The Earth Observation Center (EOC) of the German Aerospace Center (DLR) has developed a processing chain which generates standardized data products automatically, allowing the data to be reproduced easily at any time.

Tree Species Classification

Amongst others, spectral information of the corrected hyperspectral imagery as well as vegetation indices are used as input features for the classification of tree species. The reliability of the input data directly influences the reliability of the classification result.



The analysis of the input features is realized using HySpex data of three different years (2013, 2015 and 2016), all acquired during the same phenological season but with different ground resolution (3.2m, 4m, 2m pixel size).

Concerning the vegetation index, the Red Edge NDVI (RENDVI) – an indicator for the general vegetation health – is regarded exemplarily.

$$RENDVI = \frac{\lambda_{750nm} - \lambda_{705nm}}{\lambda_{750nm} + \lambda_{705nm}}$$

References

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Müller, R., Lehner, M., Reinartz, P. and Schroeder, M. (2005) **EVALUATION OF SPACEBORNE AND AIRBORNE LINE SCANNER IMAGES USING A GENERIC ORTHO IMAGE PROCESSOR**. In: High Resolution Earth Imaging for Geospatial Information, Vol. XXXVI.
Schwind, P. und Schneider, M. and Müller, R. (2014) **Improving HySpex Sensor Co-Registration Accuracy using BRISK and Sensor-model based RANSAC.** In: ISPRS Archives, XL-1, Seiten 371-376. ISPRS Archive. Pecora 19 Symposium in conjunction with the Joint Symposium of ISPRS Technical Commission I and IAG Commission 4.
Richter, R. und Schläpfer, D. (2002) **Geo-atmospheric processing of airborne imaging spectrometry data. Part 2: atmospheric/topographic correction.** International Journal of Remote Sensing, 23 (13).
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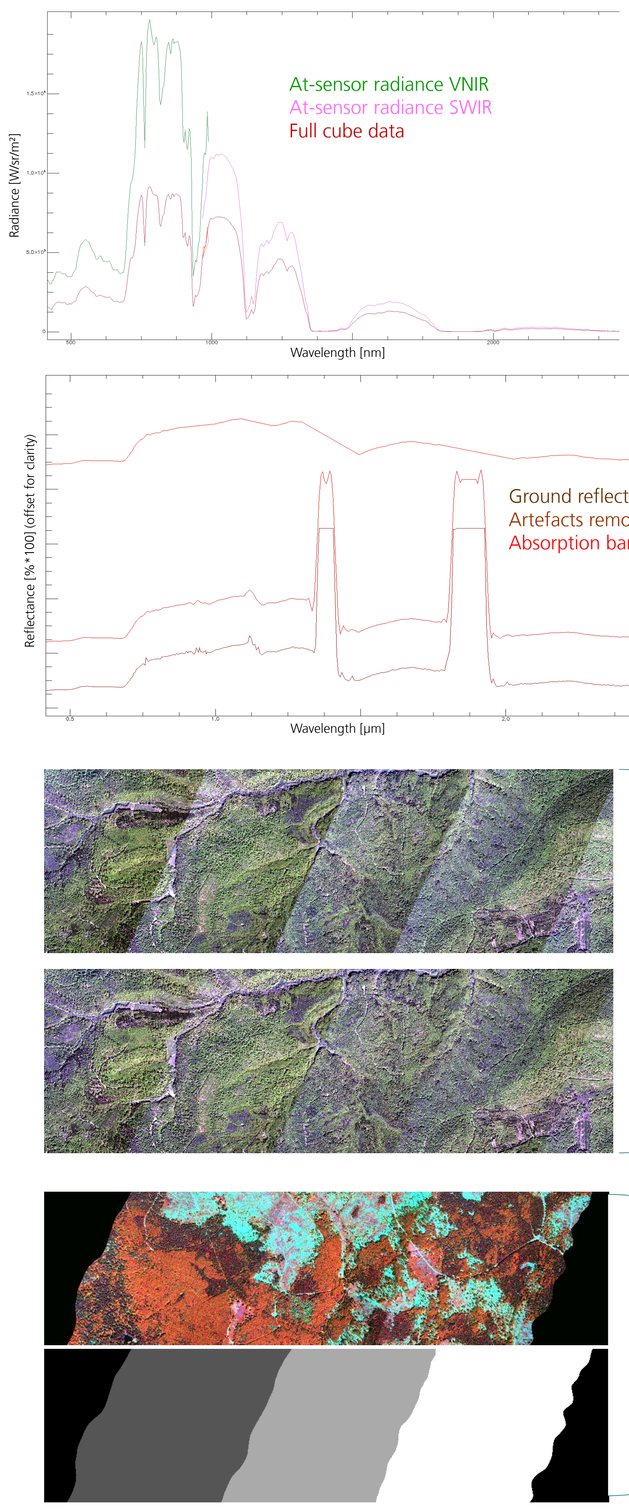
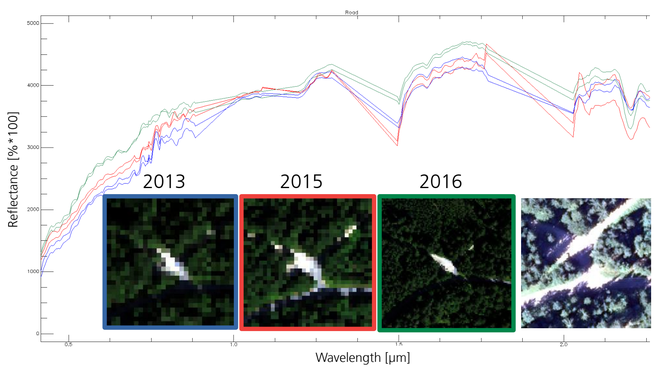
Processing Steps

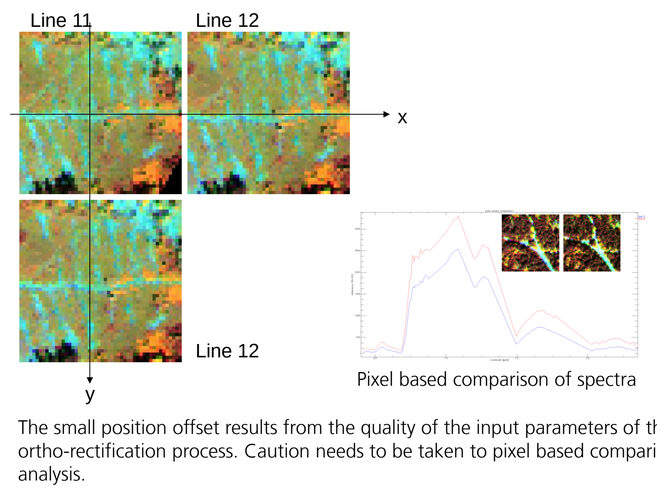


Processing Results

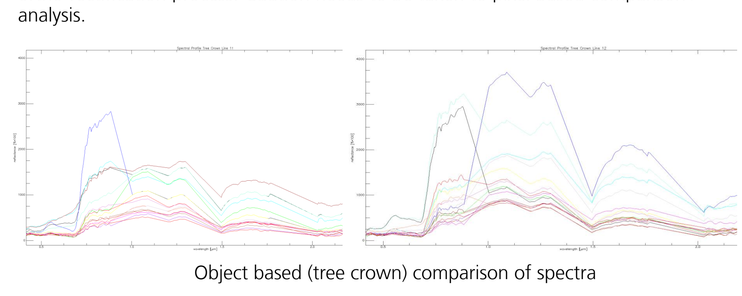
The comparability of processed data of different years can be verified by analyzing ground reflectance data of potential homogeneous surfaces (e.g. roads).



Accuracy Assessment of Two Overlapping Scenes (Same Date)



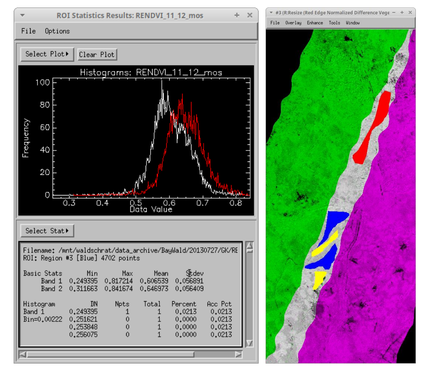
The small position offset results from the quality of the input parameters of the ortho-rectification process. Caution needs to be taken to pixel based comparison / analysis.



Object based (tree crown) comparison of spectra

The differences in spectra of the same tree in two different scenes (object based comparison) are due to BRDF effects within the crown. To correct for these effects is almost impossible due to the complexity of the forest structure.

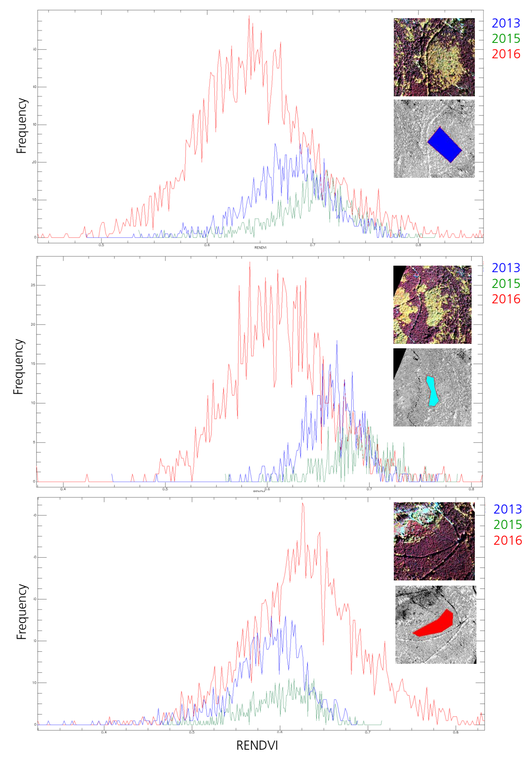
Without the correction of FOV effects, the differences due to the different viewing and illumination geometry can be depicted e.g. by looking at the RENDVI.



ROI based comparison of spectral index RENDVI

Due to the apparent differences within the overlapping area, it is essential to carefully select and filter the training data for a tree species classification.

Accuracy Assessment of Multitemporal Scenes (Same Season)



The ROI based comparison of the spectral index RENDVI calculated of corrected HySpex scenes of three different years shows a shift of the histograms. This shift is different for different tree stands (coniferous <-> deciduous). The difference in frequency is due to the different pixel sizes.

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